



# **RESEARCH *Yields* DIVIDENDS**

Kentucky Transportation Center  
Annual Report  
2003



# Kentucky Transportation Center

## ***Our Mission***

We provide services to the transportation community through research, technology transfer and education.

We create and participate in partnerships to promote safe and effective transportation systems.

## ***We Value...***

### **Teamwork**

Listening and communicating along with courtesy and respect for others.

### **Honesty and ethical behavior**

Delivering the highest quality products and services.

### **Continuous improvement**

in all that we do.



# Kentucky Transportation Center Annual Report 2003

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# Kentucky Transportation Center



*Raymond Building  
University of Kentucky, Lexington*





*Paul Toussaint, Director  
Kentucky Transportation  
Center*

## Message From the Director

Dividends paid in the research arena can be summed up in one simple term--Implementation. Outstanding management, the best scientific analysis and investigations and the finest reports mean nothing unless a conscientious effort is made to put valid research to work as soon as possible--Implementation.

Activities throughout the life of a research project are structured in a manner that we test theories as we go and with the involvement of our clients (primarily the Kentucky Transportation Cabinet). At the end of this process we have a high confidence level that recommended changes would effectively address real-world problems and have a high probability of being implemented. But this does not mean

that we (or the Cabinet) are able to proceed without risk. Whenever you venture beyond the status quo there is a risk and all too often the least chance of failure will result in staying with the tried and true (the old) vs. experimenting with the new. We at the Center try to minimize this risk and act as facilitators of change through implementation and take the burden off of our clients.

This country's future has been, and always will be, the result of someone pushing the envelop and moving beyond the status quo. It is our ability to think, react and innovate that has kept us the leader in the modern world and we at the Transportation Center have to ensure that we continue to do that in the years ahead.

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## Message From the Kentucky Secretary of Transportation

Research and technology transfer have paid huge dividends to our customers--the taxpayers of the Commonwealth--for numerous years. We depend on the Kentucky Transportation Center to deliver the best and most innovative solutions to aid the Transportation Cabinet in addressing the many challenges. Our goals of improving safety, reducing congestion, ensuring environmental stewardship and improving organizational performance benefit from timely applied research and training.

We have seen specific partnership research and development efforts pay significant benefits to Kentucky in the areas of safety improvements and environmental stewardship. I have been impressed that more than one of our

initiatives has gone beyond the Commonwealth to serve as examples to our region and the nation. Our collaboration has led to innovative "context-sensitive solutions" that place safety first while remaining sensitive to both the natural and human environment. Together we have gone a long way toward changing the culture of how we do business--we are closer to doing the right thing, in the right place, in the right way.

This is the way our road facilities should be planned, designed, and constructed and the way Kentucky deserves to have them delivered. I trust that the cooperative research and training we have initiated will continue to pay benefits to Kentucky for many years to come.



*James C. Codell III  
Kentucky Transportation  
Secretary*





# Community Transportation Innovation Academy

## RESEARCH

Highlighted Project: **Historic Farm Properties**

The research goal is to develop historic context criteria for farm properties in Central Kentucky. This will provide guidance for determining whether a property is eligible for listing in the National Register of Historic Places.

Understanding historic context will help minimize and possibly eliminate some sources of conflict during highway project development and expedite the Section 106 and 4F processes. Historic farm property types will be identified through a literature review, analysis of primary source documents and field research and documentation of selected farms. The project will include a one-day workshop.

## EDUCATION

Highlighted Project: **Professional Development Program**

The University of Kentucky and the University of Louisville jointly host a unique professional development program for mid-career professionals in government and the private sector. A small number of selected individuals are brought together each academic year for one day per month to broaden their perspectives on community impacts and consequences of transportation decisions.

Participants hear from a broad range of experts, discuss critical issues and work together in teams to find solutions to community transportation challenges. At the end of the program participants are awarded certificates to recognize their achievements.







Donn Hancher, Program Manager

## Construction Engineering and Management Research

### Major 2003 Projects

- Constructibility Issues on Transportation Cabinet Projects
- Lessons Learned System for Kentucky Transportation Projects

### Highlighted Project: **Lessons Learned System**

A system of collecting, archiving and disseminating lessons learned is a critical component of experienced-based processes, such as the design and construction of roadways and bridges. The Center's Construction Engineering and Management Program has completed the development of the Lessons Learned System (LLS) for the Kentucky Transportation Cabinet. The LLS is an Internet-based database system that archives lessons learned for Cabinet personnel, designers, contractors and other project participants. The LLS allows users to submit and query lessons learned and archives both text and graphical data. Although the LLS will initially support the Cabinet's constructability program, it was designed to collect and provide information for a number of processes within the cabinet including construction, design or other processes where the archiving of lessons learned is a worthwhile endeavor. One benefit of the LLS is that no proprietary software is required for installation on individual computers; only an Internet browser is required to access the LLS anytime and anywhere. The project developed a procedure for maintaining the LLS, which includes the role of a gatekeeper to insure the quality and accuracy of the submitted and stored lessons. The research also addressed the incorporation of the system into the Cabinet's project development process.







Tommy Hopkins, Program Manager

## Geotechnical Research

### Major 2003 Projects

- Reduction of Stresses on Buried Rigid Highway Structures Using the Imperfect Ditch Method and Expanded Polystyrene (Geofoam)
- Resilient Modulus of Aggregate Bases
- Corrosion Evaluation of Mechanically Stabilized Earth Walls
- Bearing Capacity Analysis and Design of Highway Base Material Reinforced with Geo-fabrics
- Implementation and Development of the Kentucky Geotechnical Database
- Investigation of the Soft Zone in Highway Subgrades

### Highlighted Project: **Stabilization of Soils**

Stabilizing highway subgrade soils with chemicals, such as hydrated lime, Portland cement, and industrial by-products containing cementing agents not only improves the engineering properties of the subgrade, but also prolongs pavement life. This can reduce initial construction costs from \$10,000 to \$30,000 per road mile if structural credit is given to the stabilized subgrade. Research conducted at the Center has shown that stabilized subgrades can be given structural credit as part of the pavement. Field-testing conducted by the Center concluded that chemically stabilized subgrades retain improved engineering properties even after 15 years of service. Improved bearing capacity of soil subgrades stabilized with Portland cement was still intact after 30 years. Subgrade stabilization prolongs pavement life and reduces maintenance costs







Joe Crabtree, Program Manager

## Intelligent Transportation Systems (ITS) Research

### Highlighted Project: **Model MACS**

Through the Center's partnership with the Kentucky Transportation Cabinet, Kentucky has demonstrated strong national leadership in the field of electronic screening of commercial vehicles. Kentucky now has 14 weigh stations equipped for electronic screening. Over 10,000 trucks are currently enrolled in Kentucky's system. These trucks, equipped with windshield-mounted transponders, can have their credentials and safety record verified while traveling at highway speeds, rather than exiting the Interstate to wait in line at a weigh station. This system saves time, fuel, and money for the participating carriers, enhances highway safety, and allows enforcement personnel to focus their attention on high-risk motor carriers. The "Model MACS" screening system, developed in Kentucky, also is being used in Connecticut, Georgia and New York.

### Major 2003 Projects

- System Monitoring, Ongoing Evaluation and Maintenance support for Kentucky's Commercial Vehicle Information Systems and Networks (CVISN) Program
- Development, Integration and Testing of an Onboard Commercial Vehicle Safety System (with Veridian Engineering)
- National Program Support for the North American Preclearance and Safety System (NORPASS), Inc.
- Highway Crash Site Management (with Traffic Safety Program)
- Development, Installation and Evaluation of a Virtual Weigh Station
- Developing an ITS Maintenance and Operations Plan for Kentucky
- Analysis of ITS Procurement Practices in Kentucky (with UK College of Law)
- Assessment of Data Collection for Equivalent Single-Axle Load (ESAL) Determinations (with Pavements Program and Traffic Safety Program)







Dave Allen, Program Manager

## Pavements and Materials Research

### Major 2003 Projects

- Evaluation of Current Incentive/Disincentive Procedures
- Evaluation of NDT and Geo-Physical Techniques for Subsurface Investigations
- Evaluation of Aggregate Segregation
- Utilization of Pavement Profiling Equipment to Determine As-Built Transverse and Longitudinal Profiles of Existing Highways
- Development of Pavement Distress Manual

### Highlighted Project: **Aggregate Segregation**

The ability to determine areas of pavement which exhibit aggregate segregation are invaluable in enhancing the long-term performance of a roadway. Research has indicated that pavements exhibiting aggregate segregation may have a reduction in service life of up to 50 percent. By determining the extent of segregation during project construction, remedial action may be taken at the time of construction, as opposed to disrupting the traveling public to repair a premature failure in the future. Methodologies under evaluation include ground penetrating radar, pavement permeability, surface texture and infrared thermography. The cost to rehabilitate the surface of a pavement under traffic is in excess of \$50,000 per lane-mile. The ability to detect this segregation and provide a remedial treatment at the time of construction will move the associated rehabilitation cost further into the future. This will allow a highway agency to better allocate its funding resources.







Ted Grossardt, Program Manager

## Policy and Systems Analysis Research

### Major 2003 Projects

- Annual Survey of Kentucky Highway Users
- Visualization in the Design of a Transit-Oriented Development
- Intermodal Management System
- Kentucky Highway Maintenance Evaluation System
- Kentucky TVS System Update
- Historic Wright House Adaptive Re-Use
- CVISN Support for Kentucky
- National CVISN Mainstreaming Showcase and Outreach
- Professional Development Training for Transportation Professionals
- Transportation Systems Management Graduate Certificate Program
- Cumberland Gap Tunnel ITS Evaluation
- AMIS Technical Development Project

### Highlighted Project: **AMIS**

This research project addressed the need for incorporating community input into a more comprehensive and thorough early analysis of corridor planning options using Geographic Information System (GIS)-based technology in conjunction with modern decision theory. The Analytic Minimum Impedance Surface, or AMIS, combines the data-handling and geographic analysis capabilities of a Geographic Information System with the structured input of Multi-Criteria Decision support software. AMIS breaks new ground by combining system priorities, such as economic development and connectivity improvement, with varied but specific on-the-ground features, such as wetlands, schools, median incomes or areas where endangered species are located. Both the system priorities and features can be user-specified. Input is in both written and electronic data format, while the output is displayed on standard GIS software. As they do each year, researchers for the AMIS project presented some of their findings at the Transportation Research Board annual meeting. This research may lead to an enhanced analytical tool for early roadside planning and preliminary design. This poster presentation outlined research results that will be published in the *Transportation Research Record* this year.







Issam Harik, Program Manager

## Structures Research

### Major 2003 Projects

- Testing and Calibration of the Bridge Management System
- Strengthening of the Louisa-Fort Gay Bridge With Carbon Strips
- Multi-Barge Flotillas Impact Forces on Bridges
- Seismic Evaluation of the Parkways in Western Kentucky
- Seismic Evaluation of the I-24 Corridor for Moderate Seismic Events
- Implementation of Remote Sensing Technology
- Post Earthquake Evaluation of Highway Bridges

### Highlighted Project: **Carbon Fiber Fabric Strengthening of the Carter County Bridge**

Advanced carbon fiber reinforced polymer (CFRP) composites, primarily used in the aerospace industry, have been successfully deployed in a number of highway structures. The carbon fiber material is attractive due to its high-strength-to-low-weight ratio and its resistance to corrosion and chemical attack. CFRP composites are deployed in the shell of the stealth bomber since they do not reflect the radar waves. Although the CFRP material itself is very expensive, its application as part of a retrofit system in bridges has proven to be quite economical. A prime example is the retrofit of the bridge on KY 3297 in Carter County. The spread box beams in the three spans of the bridge had severe cracks which would require the replacement of the entire superstructure at a cost of approximately \$400,000. This is in addition to the inconvenience for the traveling public. The bridge was repaired by applying CFRP fabric over the cracks in a manner similar to the application of wallpaper. The cost of the retrofit was \$100,000. After almost three years of monitoring the bridge, there has been no movement in the cracks, and the retrofit has been a great success.







Jerry G. Pigman, Program Manager

## Traffic Safety Research

### Major 2003 Projects

- Correlation Between Highway Lighting and Driver Safety
- Evaluation of Benefits and Costs and Prioritization of Highway Improvements
- Access Management Guidelines
- Effects of Pavement Resurfacing on Traffic Safety
- Traffic Crashes at Intersections
- Effect of Warning Signs on Operating Speeds
- Analysis of Traffic Crash Data in Kentucky
- Safety-Belt Usage in Kentucky

### Highlighted Project: **Roadway Lighting and Driver Safety**

The Roadway Lighting and Driver Safety project studies the potential benefits associated with roadway lighting. The goal was to determine the appropriate design necessary to provide an adequate level of lighting. Results from the analysis included the development of a procedure to identify spots or sections that have a critical number or rate of nighttime crashes. Illumination data collected at sample sites indicate that AASHTO guidelines can be met with a limited number or properly located luminaries. Recommendations from the research study were made and a plan was developed in conjunction with the Study Advisory Committee to implement the following:

- ❑ Improve the analysis tools for identifying locations in need of roadway lighting by incorporating guidance for application of nighttime critical crash rates into the *Traffic Guidance Manual*.
- ❑ Update the *Traffic Guidance Manual* to include additional warrants for roadway lighting based on crash numbers and rates.
- ❑ Review lighting design patterns to reduce the number of luminaries needed.
- ❑ Verify and evaluate existing levels of lighting at selected intersections.







Patsy Anderson, Program Manager

## Technology Transfer

The Technology Transfer (T<sup>2</sup>) Program bridges the gap between training and information needs and tight budgets for Kentucky's transportation agencies. T<sup>2</sup> can provide workshops and training events, how-to manuals, expert advice, legislative and regulatory news, on-site technical assistance, and access to the only transportation library in the Commonwealth. T<sup>2</sup> serves as Kentucky's Local Technical Assistance Program (LTAP), receiving funding from the Federal Highway Administration's (FHWA) LTAP program, as well as support from its partners, the Kentucky Transportation Cabinet and the University of Kentucky.

This fiscal year, T<sup>2</sup> assisted the Kentucky Division of Water in the delivery of two workshops on the Environmental Protection Agency (EPA) Phase II Storm Water. T<sup>2</sup> assisted in the delivery of the American Association of State Highway and Transportation Officials (AASHTO) Spring Meeting, the Governor's Highway Safety Summit, the Kentucky Transportation Cabinet's Design of Interchanges workshop, and hosted the teleconference "Integrating Right-of-Way and the Environment for Better Results." T<sup>2</sup> also presented the second Kentucky Aviation Maintenance and Operations Seminar in cooperation with the Kentucky Transportation Cabinet and the Federal Aviation Administration. T<sup>2</sup> continues to present the IMSA (International Municipal Signal Association) Level I and Level II Traffic Signal Certification training.

### Major 2003 Projects

- Presented 157 training events attended by 4,611 transportation workers
- Conducted the Asphalt Certification Program, leading to the certification of 33 new technologists and the recertification of 63 technologists.
- Issued quarterly newsletter
- Began editing a quarterly newsletter for the Kentucky Chapter of the American Public Works Association
- Added 746 items to the Library holdings and loaned 1,114 library materials, including 383 videos
- At the request of the National Transportation Library of the US Department of Transportation, Center Librarian Laura Whyne evaluated their virtual reference service, suggested some performance measures and made recommendations to improve their service.





## Fuel Tax Compliance

From its establishment in December of 1999, the Fuel Tax Compliance Unit worked within the Kentucky Transportation Cabinet until March 2002 when the project expanded to include fuel tax revenue collected by the Kentucky Revenue Cabinet. The unit now provides various types of auditing assistance to the Revenue Cabinet auditors with the following results:

- Processed 50 audits in the first 12 months
- Generated tax assessments of just under \$500,000 (\$212,382 of the assessments has been collected.)
- Seventeen audits are in process and assessments are not complete
- Revenue auditors expanded the scope of their audits and developed new policies and procedures
- Several non-compliance issues have been discovered

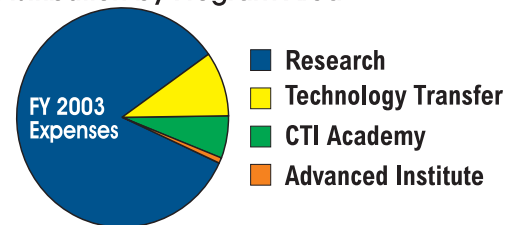
Road Fund audits have issued 35 audits with assessments of more than \$1,000,000 during this same period.

## Financial Snapshot

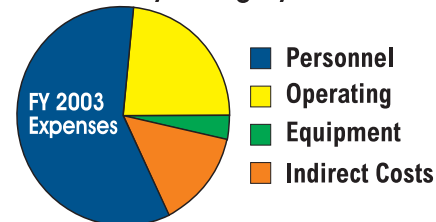
### FY 2003 Expenditures\*

Program Area Category	Research**	Technology Transfer	CTI Academy	Advanced Institute	Total
Personnel	3,776,148	390,659	264,968	60,006	4,491,781
Operating	1,310,663	346,798	119,206		1,776,667
Equipment	256,239	2,932			259,171
Indirect Costs	1,012,325		92,785		1,105,110
<b>Total</b>	<b>6,355,375</b>	<b>740,389</b>	<b>476,959</b>	<b>60,006</b>	<b>7,632,729</b>

### Distribution by Program Area



### Distribution by Category



\*Expenditure detail by subcategory of expense is available upon request (1-800-432-0719) or on the Center's Web site: [www.ktc.uky.edu](http://www.ktc.uky.edu)

\*\*The research/study program for FY03 consisted of over 100 projects conducted for the following agencies: the Kentucky Transportation Cabinet, Kentucky State Police, USDOT/FHWA, USDOT/FMCSA, NCHRP, BTS, TCRP NORPASS, TARC (Louisville), KIPDA, Lexington-Fayette Urban County Government and various other public jurisdictions. Some work is done in cooperation with other universities including: Northwestern University, University of Louisville, University of Connecticut, University of Michigan, and Calspan-University of Buffalo Research Center and also in partnership with private firms such as CH2M HILL and HMB Professional Engineers.



## 2003/2004 Kentucky Highway Research Projects

- Requirements Document for Payout Schedule (04-271)
- Developing a Database of Materials, Design, Construction, and Experimental Techniques of Pavements (04-272)
- Evaluation and Implementation Issues for the 2002 Pavement Design Guide (04-273)
- Best Management Practices for Erosion Control (04-274)
- Implementation, Maintenance, and Full Development of the Kentucky Geotechnical Database (04-275)
- Usage of GPS Technology for Traffic Crash Location (04-276)
- Evaluation of Auto Incident Recording System (04-277)
- Highway Cost Allocation Analysis (04-278)
- Develop an Archived Data Management System Prototype (04-279)
- Evaluate Methods to Limit the Time to Investigate Crash Sites (04-280)
- Testing and Calibration of the Bridge Management System (04-281)
- Impact of Outsourcing Transportation Cabinet Project Services (04-282)
- Innovative Rapid Construction Methods (04-283)

## Research Reports Published During FY 2003

KTC-03-01/TT(1)-01-1F	"Roadway Related Tort Liability and Risk Management," 5 <sup>th</sup> Edition, Kenneth R. Agent and Daniel S. Turner, January 2003.
KTC-03-02/UI4-02-1F	"Investigation of Soluble Salts on Kentucky Bridges," Sudhir Palle, Rick Younce, and Theodore Hopwood II, January 2003.
KTC-03-03/SPR224-01-1F	"Environmental Impacts of Bridge-Cleaning Operations," Sudhir Palle and Theodore Hopwood II, February 2003.
KTC-03-04/KH42-01-1F	"Maintenance Painting of Various Bridge Projects During 2001-2002," Rick Younce, Sudhir Palle and Theodore Hopwood II, February 2003.
KTC-03-05/SPR245-02-1I	"Analysis of Field Permeability and Laboratory Shear Stresses for Western Kentucky Parkway, Milepost 18 to Milepost 25 Caldwell-Hopkins Counties," David L. Allen, February 2003.
KTC-03-06/SPR177-98-1F	"Highway Rock Slope Management Program," Tommy C. Hopkins, Tony L. Beckham, Charlie Sun and Barry Butcher, February 2003.
KTC-03-07/SPR176-98-1F	"Development of a Statewide Landslide Inventory Program," Tommy C. Hopkins, Tony L. Beckham, Charlie Sun, Bixain Ni and Barry Butcher, February 2003.
KTC-03-08/SPR188-98-2F	"Intelligent Transportation Systems Statewide Architecture," Joseph D. Crabtree and Jennifer R. Walton, March 2003.
KTC-03-09/SPR258-03-1I	"Traffic Control at Stop Sign Approaches," Kenneth R. Agent, April 2003.
KTC-03-10/MS97-1F	"Structural Evaluation of the Historic John A. Robeling Suspension Bridge," Issam Harik, April 2003.
KTC-03-11/MS97-1F	"Assessment of the 1997 Commodity Flow Survey for State-Level Freight Transportation Planning," Darren M. Scott, January 2003.
KTC-03-12/SPR247-02-1F	"Roadway Lighting and Driver Safety," Eric R. Green, Kenneth R. Agent, Monica L. Barrett and Jerry G. Pigman, May 2003.
KTC-03-13/MS97-00-1F	"Evaluation of Fuel Tax Compliance Issues," James M. Clark, David Stachnik, Collene Griffin, Marlene Erickson and Jeff Keelen, January 2003.



KTC-03-14/SPR193-98-1F	"Assessment and Modeling of Stream Mitigation Procedures," Bernadette Dupont and Sudhir Palle, May 2003. (See KTC-99-52, interim report)
KTC-03-15/SPR250-02-1F	"Development of Procedures for Identifying High-Crash Locations and Prioritizing Safety Improvements," Kenneth R. Agent, Len O'Connell, Eric R. Green, Jerry G. Pigman and Neil Tollner, June 2003.
KTC-03-16/SPR269-03-1F	"Survey of Welding Processes," Theodore Hopwood, July 2003.
KTC-03-17/SPR236-02-1F	"Constructibility Issues on KyTC Projects," Donn E. Hancher, Joseph J. Thozhal and Paul M. Goodrum, July 2003.
KTC-03-18/KH43-1F	"Highway Crash Site Management," Monica L. Barrett and Jennifer R. Walton, July 2003.
KTC-03-19/SPR215-00-1F	"Reinforcement Alternatives for Concrete Bridge Decks," Chris Hill, Choo Ching Chiaw and Issam Harik, July 2003.
KTC-03-20/SPR107-01-1I	"The Use and Performance of Geogrids in Kentucky," Aric Cowne, Richard Reitenour, David L. Allen and R. Clark Graves, August 2003.
KTC-03-21/SPR258-03-2I	"Crash Rates at Intersections," Eric R. Green and Kenneth R. Agent, August 2003.
KTC-03-22/FR122-03-1F	"Pavement Evaluation, I-265 Jefferson County, MP15.0-19.0," Brad Rister, R. Clark Graves and David L. Allen, August 2003.
KTC-03-23/KSP1-03-1F	"2003 Safety Belt Usage Survey in Kentucky," Kenneth R. Agent and Eric R. Green, August 2003.
KTC-03-24/FR115-01-1F	"Evaluation of Non-Nuclear Density Gauges," David L. Allen, August 2003
KTC-03-25/SPR262-03-1F	"Lessons Learned System for Kentucky Transportation Projects," Paul M. Goodrum, Mohammed F. Yasin and Donn E. Hancher, August 2003.
KTC-03-26/KSP1-03-1I	"Evaluation of Kentucky's 'Buckle Up Kentucky: It's the Law and It's Enforced,'"
KTC-03-27/FR129-03-1F	"Evaluation of Working Capacity for Disadvantaged Business Enterprises for Highway Construction in Kentucky," Federal FY 2004 Update, Brad W. Rister, Raymond F. Werkmeister and Paul E. Toussaint, August 2003.
KTC-03-28/KSP2-02-1F	"Analysis of Traffic Crash Data in Kentucky (1998-2002)," Kenneth R. Agent, Jerry G. Pigman, Monica L. Barrett and Eric R. Green, September 2003.



# Kentucky Transportation Center Staff

**Toll Free Number: 1-800-432-0719**

**Main Number: 859-257-4513**

*Located at the Raymond Building, University of Kentucky, unless otherwise noted.*

## **Administration**

	<i>Extension</i>	<i>Email</i>
Toussaint, Paul E. ....	221 .....	toussain@engr.uky.edu
Hartman, Don .....	225 .....	dhartman@engr.uky.edu
Craycraft, Sherry S. ....	226 .....	craycraf@engr.uky.edu
Crossfield, Carla .....	224 .....	ccrossfi@engr.uky.edu
*Dunaway, Nancy .....	282 .....	ndunaway@engr.uky.edu
Mattingly, Lisa .....	222 .....	lmatting@engr.uky.edu
Riggs, Pat .....	227 .....	priggs@engr.uky.edu
Schweitzer, Kathy .....	221 .....	kschw01@engr.uky.edu
Tollner, Neil .....	257 .....	ntollner@engr.uky.edu

*\*Engineering Annex Building*

## **Technology Transfer Program**

*(Located at 310 CRMS Building, UK Campus)*

Anderson, Patsy .....	229 .....	panderso@engr.uky.edu
Horseman, Martha .....	230 .....	fegenb@engr.uky.edu
Norris, Ginny .....	270 .....	gnorris@engr.uky.edu
Pitts, Valerie .....	271 .....	vpitts@engr.uky.edu
Robinson, Nancy .....	231 .....	nrobins@engr.uky.edu
Smith, Annette .....	277 .....	aasmit3@engr.uky.edu
Whayne, Laura .....	234 .....	lwhayne@engr.uky.edu
Worthy, Nicole .....	269 .....	nworthy@engr.uky.edu

## **Research Program**

### **Construction Engineering & Management Program**

Hancher, Donn .....	257-4857 .....	hancher@engr.uky.edu
---------------------	----------------	----------------------

### **Geotechnical Program**

Hopkins, Tommy .....	249 .....	thopkins@engr.uky.edu
Beckham, Tony .....	247 .....	tbeckham@engr.uky.edu
Sun, Charlie .....	244 .....	lsun00@engr.uky.edu

### **Intelligent Transportation Systems (ITS) Program**

Crabtree, Joseph .....	241 .....	crabtree@engr.uky.edu
Hunsucker, David .....	243 .....	dhunsuck@engr.uky.edu

*Spellman, Mark .....	359-3414 .....	mspellman@engr.uky.edu
-----------------------	----------------	------------------------

*\*Waller Avenue location*

## **Pavements & Materials Program**

Allen, David .....	250 .....	dallen@engr.uky.edu
Creech, Jamie .....	258 .....	jdcre2@engr.uky.edu
Eaton, Dan .....	242 .....	deaton@engr.uky.edu
Fisher, Johathan .....	240 .....	jsfisher@engr.uky.edu
Graves, Clark .....	248 .....	cgraves@engr.uky.edu
Reitenour, Rich .....	261 .....	rreiten@engr.uky.edu
Rister, Brad .....	246 .....	brister@engr.uky.edu
Scully, Tim .....	260 .....	tscully@engr.uky.edu

## **Policy & Systems Analysis Program**

*Located at Engineering Annex Building, UK Campus)*

Grossardt, Ted .....	291 .....	thgros00@engr.uky.edu
Brumm, Joel .....	290 .....	jbrumm@engr.uky.edu
Kreis, Doug .....	287 .....	sdkrei01@engr.uky.edu
Ripy, John .....	285 .....	jripy@engr.uky.edu

## **Structures Program**

Harik, Issam .....	273 .....	iharik@engr.uky.edu
*Hopwood, Ted .....	257-2501 .....	thopwood@engr.uky.edu
*Palle, Sudhir .....	257-2670 .....	sudhir@engr.uky.edu
*Younce, Rick .....	257-6418 .....	ryounce@engr.uky.edu

*\*202 Whalen Building, UK Campus*

## **Traffic Safety Program**

Pigman, Jerry .....	252 .....	jpigman@engr.uky.edu
Agent, Ken .....	253 .....	kagent@engr.uky.edu
Barrett, Monica .....	256 .....	mbarrett@engr.uky.edu
Cain, David .....	255 .....	dcain@engr.uky.edu
Green, Eric .....	254 .....	egreen@engr.uky.edu



## Advisory Board

<u>Member</u>	<u>Agency Represented</u>
Maxwell Clay Bailey ..... Secretary, Kentucky Transportation Cabinet	Kentucky Transportation Cabinet
J. M. "Mac" Yowell ..... State Highway Engineer	Kentucky Transportation Cabinet
Thomas W. Lester ..... Dean, College of Engineering University of Kentucky	UK College of Engineering
Sandy Jones, Mayor ..... Bowling Green, Kentucky	Kentucky League of Cities
Sandy Lee Watkins ..... Henderson County Judge/Executive	Kentucky County Judge/ Executive Association
David Jenkins..... Taylorsville, Kentucky	Kentucky Association of Counties
Brad M. Meyer..... President, Haworth, Meyer & Boleyn	At-Large Member
Buddy Smith ..... McCracken County Project Engineer and Advisor	At-Large Member
Lisa Beth Wilson-Plajer.....	At-Large Member





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*Engineering Annex Building*  
*University of Kentucky, Lexington*



***For more information about any of our programs, contact us at:***

Kentucky Transportation Center  
College of Engineering  
176 Raymond Building  
University of Kentucky  
Lexington, KY 40506-0281

Voice: 859-257-4513  
1-800-432-0719  
Fax: 859-257-1815 (Administration & Research)  
Fax: 859-257-1061 (Technology Transfer)

Internet  
Kentucky Transportation Center: <http://www.ktc.uky.edu>  
Technology Transfer: <http://www.kyt2.com>  
College of Engineering: <http://www.engr.uky.edu>

